Journal of Information Systems Education

Volume 29
Issue 3
Summer 2018

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Recommended Citation: Hwang, M. I. (2018). Relationship between Teamwork and Team Performance: Experiences from an ERPsim Competition. *Journal of Information Systems Education,* 29(3), 157-168.

Article Link: http://jise.org/Volume29/n3/JISEv29n3p157.html

Initial Submission:	30 May 2017
Accepted:	23 January 2018
Abstract Posted Online:	13 June 2018
Published:	18 September 2018

ISSN: 2574-3872 (Online) 1055-3096 (Print)

Relationship between Teamwork and Team Performance: Experiences from an ERPsim Competition

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ABSTRACT

Much interest exists in using Enterprise Resource Planning simulation (ERPsim) games to help students learn complex concepts involved in Enterprise Resource Planning (ERP) systems. However, little research has explored factors that contribute to team performance during an ERPsim game. The current study investigated teamwork as a contributor to team performance in the context of a competition. The research measured teamwork in five dimensions: contributing to the team's work, interacting with teammates, keeping the team on track, expecting quality, and having relevant knowledge, skills, and abilities (KSA). Net income was the measure for team performance. Participants also rated their satisfaction with their team. Data from 62 student teams showed that all 5 teamwork dimensions had a positive correlation with net income. Moreover, all correlations were statistically significant except the relationship between keeping the team on track and net income. Teams with relevant KSA were more likely to generate higher net income. Expecting quality was the second most significant dimension, followed by interacting with teammates and contributing to the team's work. All five teamwork dimensions had a significant positive correlation with team satisfaction. This research suggests that students will likely engage in good teamwork during a game if it is set up as a high-stakes competition. Additionally, good teamwork will likely result in higher team performance and satisfaction. The evidence should encourage more widespread adoption of ERPsim games as a means for teaching and assessing teamwork in addition to learning ERP concepts.

Keywords: Assessment, Team performance, Team-oriented problem solving, Peer evaluation, Soft skills, ERPsim

1. INTRODUCTION

Enterprise Resource Planning (ERP) systems lie at the heart of IT infrastructure that supports the daily operations of modern organizations. In response, most business schools have incorporated ERP software into their curriculum. Because ERP systems are highly complex, however, students usually learn one module at a time. Teaching how business processes are integrated and supported by various modules in an ERP system remains a significant challenge (Cronan and Douglas, 2012; Hwang and Cruthirds, 2017; Seethamraju, 2011). A simulation game using SAP ERP (ERPsim) was introduced over ten years ago to allow students to experience firsthand how business processes are integrated (Léger, 2006). Part of the game's appeal is that student teams compete against each other in a simulated and yet highly realistic environment. Winning a game earns more than bragging rights; extra credit or scholarships are potential rewards. Over 200 universities worldwide have adopted the ERPsim game. The use of ERPsim games has been shown to improve student learning of ERP concepts (Cronan et al., 2011; Cronan and Douglas, 2012, 2013; Seethamraju, 2011). In addition, learning improvement has been observed whether subjective or objective measures are used (Cronan et al., 2012) and whether the setting is traditional classrooms or online learning (Hwang and Cruthirds, 2017).

Besides learning ERP concepts, the use of ERPsim games has the potential to help students learn or sharpen teamwork skills, abilities that are in strong demand in the workplace and are emphasized throughout educational institutions (Kemery and Stickney, 2014). The Association to Advance Collegiate Schools of Business (AACSB), for instance, identifies teamwork as a general skill in one of its accreditation standards, Standard 9 curriculum content (AACSB, 2016). In an ERPsim game, students assume various roles in running the business of a fictitious company. They perform highly interdependent tasks, and success is contingent on how well they work together as a team. The game provides a good opportunity to assess student teamwork as a skill required by the AACSB. Despite its importance, however, teamwork is usually assumed, but rarely, if ever, measured during an ERPsim game. In other words, students are assumed to know how to work together, but how well they work together and, more importantly, how teamwork affects team performance have received little research interest. In addition, since teamwork is a multifaceted construct (LePine et al., 2008; Ohland et al., 2012), different aspects of teamwork may have different impacts on team performance in an ERPsim game. To fill the gap in the literature, the current research seeks answers to three related questions:

1. Do students engage in good teamwork when they are playing an ERPsim game?
2. Does teamwork affect the outcomes of an ERPsim game?
3. Which aspect of teamwork has a greater impact on team performance in an ERPsim game and why?

Answers to these questions can help instructors set up the game environment properly to encourage good teamwork. As teamwork has been linked to team performance and team satisfaction in other contexts (LePine et al., 2008), better performance and higher satisfaction will likely inspire greater participation and engagement during a game. Educators can also start using the ERPsim game as a vehicle for teaching teamwork, once its relationship with team performance is better understood. Finally, teamwork data can be collected during or after a game for assessment purposes to satisfy demand from both employers and accreditation bodies (Kemery and Stickney, 2014).

2. LITERATURE REVIEW

Team performance can be conceptualized as a multi-level process in which team members engage in individual- and team-level taskwork and teamwork (Kozlowski and Klein, 2000). Taskwork refers to tasks that team members perform either individually or collectively, usually assisted with tools and machines, whereas teamwork refers to interpersonal interactions among team members (Bowers, Braun, and Morgan, 1997). It is generally accepted that effective teamwork is characterized by good communication and collaboration among team members as they work toward achieving the common goal. The outcome or product of team performance is known as team effectiveness (Salas, Cooke, and Rosen, 2008), which can be measured in different ways, including objective and self-reported team effectiveness and member satisfaction (Gladstein, 1984; Guchait, Lei, and Tews, 2016; LePine et al., 2008).

Factors that influence team performance have been the subject of extensive research. Team composition, work structure, and task characteristics have all been shown to affect team performance (Gladstein, 1984; Salas, Cooke, and Rosen, 2008). Team member behaviors that contribute to team effectiveness are also of great interest. In order to better understand pertinent behaviors of teamwork, Loughry, Ohland, and Moore (2007) developed the Comprehensive Assessment of Team Member Effectiveness (CATME), an 87-item scale (with a short form of 33 items) that classifies teamwork into five categories: contributing to the team's work, interacting with teammates, keeping the team on track, expecting quality, and having relevant knowledge, skills, and abilities (KSA). The CATME instrument provides a good measure of teamwork and can be used to study how teamwork affects team performance (Loughry, Ohland, and Moore, 2007).

A drawback to CATME (and other teamwork instruments in general) is that it is time consuming to administer. For a four-person team, even if the short form of CATME is used, each member needs to make 33 ratings for each of their teammates. In order to make the evaluation process more efficient, Ohland et al. (2012) developed a behaviorally anchored rating scale (BARS) version in which only five ratings are needed for each member rated. In essence, each member is evaluated by the five dimensions of teamwork based on a scale from 1 (poor) to 5 (excellent). Ohland et al. (2012) showed that the modified CATME was a good predictor of both team performance and team satisfaction. This instrument has many conceptual overlaps with similar teamwork scales, including the five factor teamwork test (Stevens and Campion, 1999), the peer-evaluation scale (Van Duzer and McMartin, 2000), the big five in teamwork (Salas, Sims, and Burke, 2005) and the learning partner rating scales (Kemery and Stickney, 2014). Table 1 displays the five dimensions of Ohland at al. (2012) and the descriptions of behaviors that exemplify excellent teamwork.

Contributing to the team's work
• Does more or higher-quality work than expected. • Makes important contributions that improve the team's work. • Helps to complete the work of teammates who are having difficulty.
Interacting with teammates
• Asks for and shows an interest in teammates' ideas and contributions. • Improves communication among teammates. Provides encouragement or enthusiasm to the team. • Asks teammates for feedback and uses their suggestions to improve.
Keeping the team on track
• Watches conditions affecting the team and monitors the team's progress. • Makes sure that teammates are making appropriate progress. • Gives teammates specific, timely, and constructive feedback.
Expecting quality
• Motivates the team to do excellent work. • Cares that the team does outstanding work, even if there is no additional reward. • Believes that the team can do excellent work.
Having relevant knowledge, skills, and abilities
• Demonstrates the knowledge, skills, and abilities to do excellent work. • Acquires new knowledge or skills to improve the team's performance. • Performs the role of any team member if necessary.
Source: Ohland et al. (2012)

Table 1. Teamwork Dimensions/Behaviors

In summary, teamwork, or how members of a team interact with each other, should affect team performance. While the literature in general shows that teamwork has a positive influence on team performance and team satisfaction (LePine et al., 2008), a few studies have produced inconsistent results. In a study of 100 sales teams in the communications industry, Gladstein (1984) found a positive association between teamwork and self-reported team effectiveness and satisfaction, but a nonsignificant relationship between teamwork and sales revenues. Miller (2001) investigated whether team skills were associated with team performance and satisfaction. In a sample of 42 groups of undergraduate management students tasked to run a simulated business, the students' scores on team skills

correlated with neither their team's performance on completion of required organizational tasks nor team satisfaction. More recently, Guchait, Lei, and Tews (2016) explored the effect of different types of team knowledge on team performance. In a study of 27 groups of undergraduate hospitality management students tasked with running a simulated restaurant business, they found that team effectiveness and satisfaction were both positively related with teamwork knowledge but not with taskwork knowledge. Despite these exceptions, the positive impact of teamwork on team effectiveness and satisfaction should be replicable in the ERPsim context in accordance with the literature (LePine et al., 2008). Consequently, the current research proposes the following two hypotheses:

H1: Teamwork will have a positive relationship with team effectiveness.
H2: Teamwork will have a positive relationship with team satisfaction.

3. METHODOLOGY

The research venue is an annual ERPsim competition held at a Midwest university in the United States. The competition is open to all business undergraduate and graduate students. Students from all common majors are represented, although the largest groups are composed of information systems and accounting majors. Most graduate students are in the information systems program with the rest consisting of economics majors and MBA students. The only prerequisite is that they have taken an ERP fundamental class, where they learn business process integration, execute business transactions using SAP, and play one of the ERPsim games.

Students can choose their own teammates or be assigned to teams of four to five members. The object of the game is to maximize profit from the sales of six different products. Profitability is a function of team activities involving business areas including marketing, sales, production planning, procurement, and logistics. The outcome of the game is dependent on timely execution of business strategies in various functional areas that are highly interdependent. As the game progresses, participants can experience firsthand how their decisions in one area impact other areas and how these collective decisions in turn affect the net income of their team. Students quickly learn the importance of teamwork, the need to exchange information swiftly, and the need to follow the correct sequence of transactions when playing the highly complex and interdependent game.

The game is usually played in three rounds, each consisting of 20 days. At the end of each round, all teams' financial results along with team standings are posted, which allows strategy adjustments in each of the functional areas such as marketing or sales. During each round, any team can also adjust its business strategies based on financial results available at the end of each simulated day.

The simulation program runs on top of an SAP ERP system which automates a number of background transactions and simulates the passage of time. To speed up the game, each simulated day is usually set at one minute or even 30 seconds, making it a fast-paced and high-intensity game. All students have played some version of the game in previous classes, where they may receive extra credit for playing. The stakes are much higher in the competition due to the involvement of corporate sponsors.

For the competition, each team was assigned a corporate sponsor which donated company shirts and mentors to work with student teams on fine-tuning business strategies needed to win the game. Many companies provided multiple mentors, and several companies sponsored more than one team. In 2017, 70 mentors from 29 companies participated. Most of the companies were SAP customers, but a few used other ERP systems. Their involvement was motivated by seeking out potential hires that could "perform well as a team under pressure." Many mentors worked closely with their assigned teams starting from practice runs several months prior to the competition, forming a close bond with the teams. Impressed with students' performance, not only in the game outcome but also in the way they worked together as a team under pressure, internships and job offers have been made on the spot at the conclusion of the competition. A firm, which was not an SAP customer, was so impressed with its team that the mentors made job offers to the entire team immediately after the game. Consequently, students strived to put their best effort forward in front of their mentors. Scholarships offered to winning teams provided additional motivation for better performance.

The day of the competition started at 11:00 AM, when corporate representatives and mentors began to arrive. In addition to working with their team in final preparation, corporate partners could mingle with the faculty, staff, and administrators. The competition kicked off after lunch and started with game one in three rounds. The teams were then split into two flights based on results of game one, with the top 20 teams in flight one and the bottom 20 teams in flight two. Teams in each flight competed against each other in game two, which also lasted three rounds. The five most profitable teams at the end of game two in each flight would receive scholarships. The games lasted a good portion of the afternoon. The event continued with a dinner banquet and concluded with the announcement of the championship team and awards presentation. In the last two years, the event took place at the university basketball arena which was decorated with company banners. With close to 300 participants and spectators, it was an exciting event for both the student teams and their mentors. In sum, students were doing their very best to come out on top rather than treating the competition as just another school activity.

The CATME website (info.catme.org) was used to collect teamwork and team satisfaction data. Each student was instructed to register with the site and get familiarized with the five dimensions of teamwork. They were asked to fill out the web survey to evaluate every member of their team, including themselves, on the day of the competition after the game. Two reminders were sent in subsequent weeks to encourage more participation. Data were collected from the event in 2016 and 2017. Each year, 40 teams participated – 32 teams responded to the survey in 2016 and 30 teams did so in 2017, resulting in a sample of 62 teams with a response rate of 78%. Profitability of each team was measured by its net income at the end of the game. Teamwork was measured by the five dimensions individually and also collectively with a single composite score, which was the average of the five dimension scores. Team satisfaction was measured by a three-item scale adopted from Van der Vegt, Emans, and Van de Vuert (2001). Using a scale

of 1 (strongly disagree) to 5 (strong agree), students answered the following three questions:

1. I am satisfied with my present teammates.
2. I am pleased with the way my teammates and I work together.
3. I am very satisfied with working in this team.

A composite satisfaction score was calculated by averaging the three satisfaction scores. Team effectiveness was measured by net income accumulated by each team at the end of the game. This is an objective measure and should be a better indicator of team performance than self-reported effectiveness. Net income and team satisfaction were correlated with teamwork to test the two research hypotheses.

4. RESULTS

Table 2 displays the means and standard deviations of all study variables and their inter-correlations. The means of all five teamwork dimensions are over 4.20 on a five-point scale, indicating good teamwork. The composite mean is 4.26, slightly higher than the 4.14 observed in the sample of Ohland et al. (2012). Cronbach's alpha of the teamwork variable is 0.91, indicating strong internal consistency. In addition, all five dimensions have a very significant correlation (all > 0.81) with the composite. Overall the quantitative evidence supports the assumption that students engaged in good teamwork during the competition. Qualitative evidence of teamwork can be seen from the answers to the last question on the survey, which asked the students to provide any confidential comments. Appendix A displays unedited comments from the competition in 2016. Most of the comments were related to teamwork and the majority of them were positive. Figure 1 is a word cloud created from the 25 most common words along with their frequencies. As can be seen in Figure 1, the students' comments included many common words related to teamwork, including "communicate," "team," and "teammates."

Good teamwork can be attributed to the great efforts put forward by the students in front of their mentors as explained earlier. Another possible reason is that the students are exposed to what good teamwork entails as described in the CATME instrument. The use of self- and peer-evaluation can help students develop team skills and become effective team members (Hughes and Jones, 2011; Ohland et al., 2012). Good teamwork in turn may have contributed to a high degree of team satisfaction, which has a mean score of 4.48, the highest among all measures.

Also, as shown in Table 2, all five teamwork dimensions have a positive correlation with net income as hypothesized. Moreover, every correlation is significant at the five percent or lower level except the correlation between keeping the team on track and net income ($r = 0.110$, $p = 0.198$). The composite of the five dimensions also has a significant correlation with net income ($r = 0.264$, $p = 0.019$). The evidence strongly supports Hypothesis 1 and indicates that teamwork has a significant positive relationship with team effectiveness, as measured by the net income generated by the teams engaged in an ERPsim competition. In regards to individual dimensions, the most important is having relevant knowledge, skills and abilities, followed by expecting quality, interacting with teammates, and contributing to the team's work, in that order. Hypothesis 2 is fully supported as all five dimensions and the composite show a significant positive correlation with team satisfaction.

	Mean	SD	1	2	3	4	5	6	7
1. Contribution	4.24	0.63	-						
2. Interaction	4.32	0.66	0.780						
			0.000						
3. Keeping on track	4.21	0.57	0.700	0.645					
			0.000	0.000					
4. Expecting quality	4.29	0.60	0.689	0.579	0.635				
			0.000	0.000	0.000				
5. KSA	4.22	0.64	0.744	0.725	0.711	0.602			
			0.000	0.000	0.000	0.000			
6. Composite	4.26	0.54	0.909	0.870	0.848	0.808	0.879		
			0.000	0.000	0.000	0.000	0.000		
7. Net income	$274,344	$47,117	0.214	0.225	0.110	0.245	0.334	0.264	
			0.047	0.040	0.198	0.027	0.004	0.019	
8. Satisfaction	4.48	0.63	0.442	0.526	0.421	0.274	0.468	0.497	0.236
			0.000	0.000	0.000	0.016	0.000	0.000	0.033

N = 62
P-value is shown below each correlation.

Table 2. Means, Standard Deviations, and Correlations

Figure 1. Word Cloud of Student Comments

5. DISCUSSION

Team performance is a function of many factors, among which teamwork is generally considered an important determinant of team effectiveness and member satisfaction. While it is commonly accepted that effective teamwork results in better team performance (LePine et al., 2008), the positive influence of teamwork on team performance has not always been borne out in empirical studies (e.g., see Gladstein, 1984; Guchait, Lei, and Tews, 2016; Miller, 2001). The current research extends team research to a highly-competitive simulation game using an ERP system by seeking to determine if students exhibit good teamwork during a game and whether teamwork in turn affects team results. The evidence suggests that the answer is affirmative to both research questions. The result is significant because in this game the product of team performance is net income, a tangible benefit that any business students or professionals can appreciate. The finding on team satisfaction also confirms the link between teamwork and team satisfaction, which not all prior studies were able to establish (e.g., see Miller, 2001). The eagerness of students to perform well in front of their mentors likely caused them to work hard as a team, and the results are reflected in the game outcomes.

This is an encouraging finding for instructors looking to incorporate simulation into their classes in general and ERPsim games in particular. ERPsim games have been shown to be excellent vehicles for learning ERP concepts (Cronan et al., 2011, Cronan and Douglas, 2012, 2013; Hwang and Cruthirds, 2017; Seethamraju, 2011). As shown in this research, the games are equally well-suited for teaching and learning teamwork, provided they are set up in a way that students are highly motivated to achieve team effectiveness. This means that merely giving credit for participation is probably not enough; instructors will need to find ways to substantially increase the stakes of the games.

Even though the importance of teamwork is commonly accepted, there is no consensus on how it should be taught. This research shows that ERPsim games can be a good vehicle for learning or enhancing teamwork skills, provided students are subjected to proper training. At a minimum, before a game is administered, students should be exposed to various teamwork dimensions and the proper behaviors for each dimension. Hughes and Jones (2011) suggest that items on the CATME or similar teamwork scales be introduced at the beginning of a student project to facilitate "educative assessment" (Wiggins, 1998) so that students know how to effectively contribute to their team's work. Given the increasing adoption of the games, if teamwork data are collected in each game, they can be analyzed and used for assessment purposes to satisfy the requirement of both employers and accreditation bodies.

In addition to evidence that students engage in good teamwork during a game and that their teamwork is positively related to team outcomes, the current research also provides evidence to support the different effects of different dimensions of teamwork. Researchers have shown that teamwork is a multifaceted construct with highly correlated individual dimensions (LePine et al., 2008; Ohland et al., 2012). Furthermore, some dimensions can have a greater effect on team performance than others (Mathieu et al., 2008). The current research shows that having relevant knowledge, skills, and abilities has the most significant relationship with team performance. This is not surprising, as ERPsim games are sophisticated, and winning requires members with expertise in different functional areas to work closely together under time pressure. In this circumstance, a team's performance depends primarily on whether the team possesses the required knowledge, skills, and abilities to make the correct business decisions that impact the bottom line. Having the required taskwork knowledge has been shown to have a positive impact on team effectiveness (Guchait, Lei, and Tews, 2016), especially when the task complexity or task interdependence is high (LePine et al., 2008). Because business processes are highly integrated, mastery of taskwork knowledge needed to complete highly complex and interdependent tasks is crucial to winning an ERPsim game.

The second most important dimension is expecting quality. Teams that believe they can do excellent work together and are motivated to do so are likely to achieve better results. This finding is consistent with what most educators intuitively believe: setting high standards is good for student learning and performance. This dimension is closely related to team accountability, a component of cooperative learning (Johnson, Johnson, and Smith, 1991). Teams that hold each member accountable for team performance are likely to be more

effective (Hoegl and Gemuenden, 2001; Kemery and Stickney 2014).

Interacting with teammates is the third most important contributor to team performance in ERPsim games. This dimension is related to team communication and includes aspects of how team members share information and how they respond to feedback. Effective communication and providing constructive feedback are generally considered important teamwork components (Kemery and Stickney 2014; Salas, Sims, and Burke, 2005; Stevens and Campion, 1999). Teamwork knowledge has also been found to have a positive impact on team effectiveness (Guchait, Lei, and Tews, 2016).

The next important teamwork dimension is members' contribution to a team's work. Members get high marks if they perform higher-quality work than expected, make important contributions to improve the team's work, or help teammates who have difficulty completing their work. This dimension is related to the actual contribution made by individual members to the team's work. Tangible contributions to the improvement of the team's work is important, as is assistance provided to teammates who are having difficulty completing their work. The last behavior hinges on monitoring the work of teammates and providing backup on demand, which have been found vital to team effectiveness (Marks et al., 2002; Marks and Panzer, 2004; Porter, 2005; Porter et al., 2003).

The last teamwork dimension, keeping the team on track, was not found to have a significant correlation with team performance. Monitoring the team's progress and making sure that each member is making appropriate progress are important aspects of teamwork (Marks et al., 2002). The reason for the nonsignificant finding in this research may be that performance monitoring is an integral part of a high-intensity, high-stakes ERPsim game. As a result, if every team is monitoring its performance in a similar degree during the game, it will likely not be a differentiator in the final outcome. Among the five teamwork dimensions, keeping the team on track has the smallest standard deviation, suggesting homogeneity of this measure and hence its inability to function as a predictor of team performance in the ERPsim game. This finding can be further investigated in a future study.

Finally, all five teamwork dimensions had a significant relationship with team satisfaction. This finding is consistent with the literature (LePine et al., 2008; Ohland et al., 2012). Teams that work well together are happy with their teams and are willing to work together again in the future. The literature suggests that ERPsim games have a positive effect on student learning, however, student satisfaction has not been measured in prior studies. The current research provides strong evidence of student satisfaction with ERPsim games, further strengthening the case for their adoption in educational settings.

6. CONCLUSIONS

Teamwork is a skill highly valued in the workplace and a topic emphasized in business schools. In order to satisfy the requirements of AACSB, teamwork should be built into the curriculum and assessed accordingly. One of the learning activities that lends itself to teamwork is the ERPsim game, which was developed to help students learn complex ERP concepts. Because students work in teams while playing the game, it represents a good vehicle to help students develop their teamwork skills, in addition to learning ERP concepts. With increasing adoption of ERPsim games in business schools, it will be important to assess teamwork that transpires during an ERPsim game and also how teamwork affects team performance.

The current research investigated teamwork and team performance in the context of an ERPsim competition. Because of corporate sponsorship, the competition has become a high-stakes game that induces high levels of teamwork. Teamwork, in turn, has a positive relationship with team performance as indicated by an objective profit measure and team satisfaction. The results are consistent with most of the literature and represent encouraging news for instructors looking to incorporate ERPsim games into their classes. The expected benefits include enhanced learning of ERP concepts and learning or sharpening of teamwork skills. In addition, student satisfaction can be expected to increase with the use of the ERPsim games. All of these benefits are more likely to manifest if students are strongly motivated to win an ERPsim game rather than treating the game as simply a class activity.

Another use of ERPsim games is to teach teamwork. Behaviors that exemplify good teamwork (Ohland et al., 2012) can be discussed in class to help students collaborate more effectively in playing an ERPsim game. Instructors can elect other teamwork scales if they so choose to teach and measure teamwork during a game. As shown in this research, the use of self- and peer-evaluation of teamwork can cause students to work better together during a game, which in turn will cause an increase in team performance and team satisfaction. Additionally, teamwork data collected during a game can be used for assessment purposes.

Research on ERPsim games can be extended in several directions. Researchers can investigate other factors that can contribute to team performance during a game. For example, team emotional intelligence and trust can affect team creativity and hence team effectiveness (Barczak, Lassk, and Mulki, 2010). Team emotional intelligence refers to awareness of self and peers' emotions and the management of those emotions (Jordan and Lawrence, 2009). It has been shown to affect collaboration and team cohesiveness, both of which are important to team effectiveness (Druskat and Wolff, 2001). It will be interesting to examine the effects of team emotional intelligence, teamwork, and team cohesiveness on team performance during an ERPsim game.

Another antecedent of team performance worthy of further study is team building, which can include activities oriented toward goal setting, establishing interpersonal relations, problem solving, and role clarification (Salas et al., 1999). Team building has been shown to affect team cohesiveness and team performance (Bahli and Buyukkurt, 2005). ERPsim games are usually played in several rounds spanning multiple days. In the case of the ERPsim competition, several practice rounds have also been conducted over a long period of time, thus providing a good opportunity for team building. It will be interesting to see if the effect of team building on team performance can be replicated in an ERPsim game.

Another extension can explore teamwork and related variables in an online environment. Prior research has shown the benefit of enhanced learning of ERP concepts from ERPsim games in online classes (Hwang and Cruthirds, 2017). However, collaboration or teamwork can be a challenge when

members of a team are separated by time or space (Espinosa, Cummings, and Pickering, 2012; Strauss, 1996). It remains to be seen whether an increase in teamwork and the effect of teamwork on team performance can be replicated in an online setting.

Finally, it has long been recognized that technological tools can improve team performance (Salas, Cooke, & Rosen, 2008). For ERPsim games, researchers have developed dashboards to help teams visualize and analyze data more effectively (Babin et al., 2011). The dashboards were built first using Excel and later SAP Lumira. The need for collaboration in ERPsim games makes them ideal activities supported by collaborative visualization, the "visual representations of data by more than one person with the common goal of contribution to joint information processing activities" (Isenberg et al., 2011, p. 312). Advanced visualizations and decision models can be developed in the future to support teams making quicker or more effective decisions during a game. How these tools will impact teamwork and team performance in both face-to-face and online environments is a promising research stream.

The current study has several limitations that warrant caution in the interpretation of the research results. The first limitation is the measurement of teamwork. Although the CATME instrument has strong validity and reliability properties, it suffers from the problems associated with all self-reported measures. A high mark can represent true teamwork or it can be due to some members trying to be nice. This problem can be somewhat compensated in future research where teamwork is also assessed by other means such as by the mentor or a faculty member. However, it will require additional work on the part of the mentor which may not be feasible given their busy schedules.

The presence of mentors, although a positive factor for fostering teamwork, represents another potential confounding effect. Some mentors are more involved than others, which may have contributed to team performance differences. A related limitation is team composition, which has been found to affect team performance (Gladstein, 1984; Salas, Cooke, and Rosen, 2008). In order to encourage participation, students are allowed to form their own teams. Other students are assigned by the faculty. Team assignment of mentors is similarly mixed; several mentors have requested to be assigned to teams with certain compositions (e.g., undergraduate vs. graduate student teams) while the rest are assigned by the faculty. There are also student requests to have certain mentors assigned to their teams because they are interested in a particular company. Although these types of requests are not common, they are accommodated in order to draw more student interest. These are all good practices to encourage greater participation from both the mentors and the students, but they also represent potential confounding factors.

In conclusion, teamwork is an important skill that can be learned and hence should be taught to college students (Hughes and Jones, 2011). Business faculty have long used simulations to teach teamwork (Faria and Wellington, 2004) with encouraging results (e.g., see Levant, Coulmont, and Sandu, 2016). IS educators have used ERPsim games to teach complex ERP concepts. This research has shown that ERPsim games are equally suited for teaching and assessing teamwork, if the games are set up as a high-stakes competition. In such an environment, good teamwork will likely result in greater team performance and satisfaction. Of course, other factors besides teamwork can affect team effectiveness. IS researchers are urged to extend the research stream to investigate additional factors that contribute to team performance during an ERPsim game.

7. ACKKNOWLEDGEMENTS

The author thanks Steve Tracy for providing ERPsim competition data for this research and is grateful for the helpful comments of six anonymous reviewers.

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Appendix A. Unedited Student Comments on the Competition

Thanks ERP SIM COMPETETION. We learned a lot with this game and thanks to all my team mates.
I loved to be part of this team and they were encouraging too
I really enjoyed working with this team. I believe we had a lot of fun together even though we may not have won. It was a great experience and every member seemed to care about the success of the team. Everyone was open to suggestions and listened to each other. XXXXX went above and beyond to create a dashboard and analyze data. I feel that he deserves an extra shout out for that.
For the most part our team worked very well together. One member did not show the same interest as the other three. The other three worked around this for the most part. Communication was great between three of the members while one often fail to update the rest of the team. There were some absences from a teammate that were not communicated prior to the other teammates.
While the team worked together wonderfully, XXXXX exhibited truly professional work and leadership.
I enjoyed working with this team. All of the members tired their best and it was a great experience. Thank you for the opportunity!
Great learning process and always be patient!
I enjoyed playing this game. We improved a lot from where we originally begun. We fall apart in making Business analytics using dashboard since the dashboard was not available till the before week of the game day. However we made learned about market and price sensitivities by analyzing data after each practice session by pulling data to excel sheets.
Thank you, every professor gives us help.
I Had Great team who supported each other very well. That's the reason we stood as champions. And Every professor helped us a lot in the practice sections. Thanks to Everyone!
wish our team could have worked with more team work rather than depending on one single persons ideas
we have a great work in this competition. Everyone show our team professional skills, we have cooperation and collaboration. I feel satisfied with my teammates.
good experience. Good teammates. good mentors.
good understanding and explanation of ERPsim game willing to teach us communicate friendly Overall: Good Job!!
I enjoyed each person on this team and felt that they contributed to our success. However, the team committed to meeting at every Saturday practice and then having strategy and data analysis meetings after each of these and then never actually stayed to do so. XXXXX attended the most practices but did not always communicate his actions or planned actions to the rest of the team making it hard to do PIR effectively. He often did not respond/hear me asking for input or updates, this was challenging for me. XXXXX communicated very well and brought a lot of positive enthusiasm to the group. His presence and communication efforts added a lot of positive energy to the team. XXXXX worked very hard at practice and during the competition to help our team win with effective warehouse and logistics management, but she did not communicate with the group very much and often mumbled at practice or did not acknowledge me when I spoke to her. Our communication and coordination was critical to be in sync. I put quite a bit of time and energy into communicating as the liaison and trying to get the team to communicate with each other and keep our commitments. I pulled down most of the data but felt it was nearly pointless since the team never had any meetings to analyze the data after practice. Furthermore, our mentor did not wind up helping us with data analysis tools and ongoing strategy input or discussion. He travels overseas for his work all the time and was only available for one brief phone meeting and one practice. He did bring three mentors with him to the competition which was helpful and encouraging. Unfortunately, his firm was not hiring at all and could not make any job or internship offers to us. Overall score for team in regards to total effort that your team spent monitoring and analyzing market condition is 4
What a wonderful event! Thank you so much!
I enjoyed working with my Team! We finished off on a high note!
Good experience
Thank you very much
I thought the team worked really well together! Last year I had an issue with a teammate who did very little so it was a breath of fresh air this year to get a team who were all very interested in doing well and showing up to prove it.

I am really happy for being in team where team members really worked hard which paid off by receiving third position in flight 1. I must appreciate for excellence of work done by my team mates XXXXX, XXXXX and XXXXX. XXXXX and XXXXX did work regarding inventory pulling things, me and XXXXX did pricing and checking reports. We four did good team work which helped us to win the game!
Our team did very well as far as contributing in the practice rounds. We all got a long very well and showed up to every practice we could. Overall, for myself, this has been an awesome experience.
ERPsim completion gave me a good experience.
I believe that the ERPsim competition was a great experience and really allowed my team and I to learn a lot about ourselves by competing together.
Thanks for XXXXX for helping me writing the Practice Section Report to share with the team and the mentor. And very much thanks to all the faculties and stuffs who prepared the event for us!

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ISSN 2574-3872